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RAMSES: a multiscale system for railway hazard mitigation. First results and perspectives.

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To mitigate the impact of intense flash flooding on the Calabria railway lines and improve the management of emergencies, a short-time range forecasting system has been developed by an Italian team of scientists of the National Research Council (CNR), supported by the Calabrian Multirisks Functional Centre of ARPACAL-Regione Calabria, within the frame of the RAMSES (RAilway Meteorological Security System) Project, funded by Rete Ferroviaria Italiana (RFI S.p.A.).
The main goal of the Project is the development of a prototypal architecture to perform meteo-hydro-geological analyses and forecast the impact of convective precipitation events on small catch basins (< 50 km2) crossing the railway lines. The warning system is organized in 4 predictive steps, covering 24 hrs.
• At time T=0 h, rainfall intensity is estimated (nowcasted) by local weather radar and rain gauge measurements. In case of lack of ground data, instantaneous rain rates are computed by the satellite blending methods, by combining Meteosat Second Generation (MSG) infrared images and passive microwave rain maps. On a 1-km resolution grid, covering the whole Calabrian region, precipitation estimations are used to calculate the flow rates in the catch basins crossing the rail track, which are, then, compared to the runoff capacity of the crossings. The prompt knowledge of approaching risks is highly important for an effective management of transportation infrastructures (like railways), especially in terms of alerts for constraining the transit of the trains threatened by hazardous phenomena like flash floods and shallow landslides (including debris flows).
• The second time step, still belonging to the nowcasting phase, occurs at T=0.5 h, when the results of comparisons among several inferential techniques (e.g. Titan, Nefodina), based on weather radar and Meteosat, are provided. Such techniques allow to identify the trajectories of the storm cells and to forecast their near-future locations. Once their future position are defined, flow rates are computed/updated.
• At T=0÷3 h, the third forecast is provided by LAPS-WRF modelling: ground-based measurements (e.g. from weather radar, rain gauges, radiosondes, and METAR) and MSG images are taken into account, and models are re-initialized every 3 hours.
• Finally, in the last step, rainfall estimations are ingested by a rainfall-runoff model to assess the flow rates after three hours. By using the RAMS numerical model, specifically customized on the morphology of Calabria, a rainfall forecast at T=24 h is produced to get a rough evaluation of the weather trend.
The RAMSES operational chain can be visualized via a user-friendly WebGIS site. Here, the study areas can be monitored in terms of forecasted weather conditions. In addition, scenarios of expected geomorphic effects on the slopes and along the drainage network, evaluated for a set of return periods (from 25 y to 200 y) can be examined, to get insights on potential dangers at railway crossings and along the coastal sectors of the study areas. In case of alerts in the next 24 h, basins are listed and marked with coloured circles, by adopting a traffic-light scheme.
The early-warning system is presently undergoing a phase of test and validation against historical events. The final results of the Project RAMSES are expected by the end of 2017.